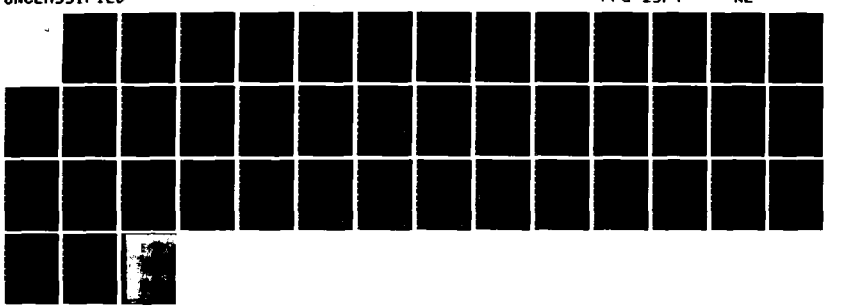
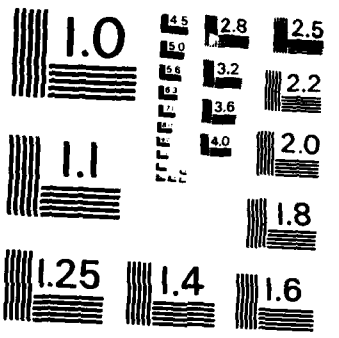
AD-A142 286 METHANOL/WATER FUEL CONTAINER FOR 15 KW FUEL CELL POWER 1/1
UNIT(U) LOGICAL TECHNICAL SERVICES CORP TRENTON NJ
B DRAEGER ET AL. FEB 84 DAAK70-81-C-0194

UNCLASSIFIED F/G 13/4 NL





LOGICAL TECHNICAL SERVICES CORP.
FEDERAL SYSTEMS DIVISION
675 Prospect Street Trenton, NJ 08618
(609) 393-2222

1 June 1984

U.S. Army Mobility Equipment Research
and Development Command
Procurement and Production Directorate
Fort Belvois, VA 22060

ATTN: Mr. Stanley S. Kurpit - STRBE - ECS

SUBJECT: Contract DAAK70-81-C-0194 Final Report Type III
CLIN 0005, A002, and A004

On 16 March 1984, Logical Technical Services Corp., submitted a final report on the methanol/water fuel container program.

Twenty four (24) copies of an updated final report are enclosed.

Sincerely yours,

Logical Technical Services Corp.

F.O. Perry
Manager, Instruments Division

cc: STRBE - ECS 10
DRCPM - MEP-T 1
STRBE - VK 1
DDC 12

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
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18. SUPPLEMENTARY NOTES

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Methanol/Water Fuel Container, Methanol Fuel Cell Power Unit, High Density Polyethylene, Blow Molding, DOT Spec. 34

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A blow molded container of high density polyethylene has been developed to store methanol/water fuel (58% methanol) before and during use as a supply for a 1.5 KW fuel cell power unit for use in forward field positions by the US Army. Also included is accessory hardware needed to transfer the fuel. A limited number of containers and hardware have been delivered to the US Army Belvoir Research and Development Center. This work demonstrated the technical feasibility of producing the container in volume.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

TABLE OF CONTENTS

TABLES

A-1

1. INTRODUCTION

The purpose of Contract DAAK 70-81-C-0194 was to design, develop, test, and deliver to the Tactical Energy Systems Laboratory of the U.S. Army Belvoir Research and Development Center, thirty eight (38) contaminant free containers capable of storing methanol/water fuel and the hardware necessary to allow the transfer of fuel to a 1.5 KW fuel cell power unit.

A blow molded, high density polyethylene container of approximately 4.5 gallon capacity was developed to satisfy these requirements.

2. DESIGN REQUIREMENTS

2.1 Type

The containers shall be reusable or disposable, depending on the cost criteria established in Section C, paragraph C.2C of the contract.

2.2 Use

The container and the transfer hardware shall be useable with methanol/water fuel only and unuseable with other hydrocarbon fuels, such as gasoline, diesel, or avaiation fuel.

2.3 Chemical and Weathering Resistance

The containers shall be useable and storable full or empty for five years without significant structural or cosmetic degradation under the environmental conditions specified in AR 70-38, Climate Categories 1-8. The material used to fabricate the container shall not be bleached out by the fuel for at least a five year period.

2.4 Color

The container shall be Forest Green in accordance with MIL-E-57298A, Amendment 2, dated 3, March 1980 (Enamel, Alkyd, Camouflage). Any paint used shall be impervious to the fuel.

2.5 Human Factors Engineering (HFE)

The handle and gross weight of the container shall be designed to meet the human factors engineering requirements of MIL-STD-1472B. The container shall be readily distinguishable from presently used Army hydrocarbon fuel containers and distinctively marked as to its contents. A warning prohibiting human ingestion of its contents shall also be provided.

2.6 Durability

The container shall withstand rough handling and when full, resist drops of six feet without breakage or malfunction at temperatures of -25, 70 and 125 degrees F. In addition, the container shall meet DOT regulations covering the commercial shipment (surface and air) of fuel.

3.0 DESIGN TRADE-OFF STUDIES

Various container designs were evaluated before the final design configuration was established. The following paragraphs summarize the design trade-off studies which were accomplished.

3.1 Disposable Versus Resuseable Containers

Disposable containers were initially evaluated for design conformance and cost effectiveness. Types of containers considered included:

a. Blow molded or vacuum formed polyethylene containers
b. Rubber bladders
c. Heat sealed polyester terephtholate pouches

In all of the above alternatives, existing "off the shelf" containers were assumed in order to keep the price of procuring the container to a minimum. When evaluating alternative (a) it was found that none of the existing molded or vacuum formed polyethylene containers met the human factors engineering requirements (handle clearance) needed when performing fuel transfer operations. Vendor history on this type of container did indicate that the container material had survived drop testing equivalent to the testing required for this program. The cost to produce this type of container though was high and determined to be inappropriate as a throw-away item.

Alternatives (b) and (c), the rubber bladder and polyester pouches, were more cost effective than alternative (a) but vendor history indicated that they would not survive the required drop testing. A protective metal or plastic frame was considered for encasement of both alternatives, but was also determined to be insufficient when undergoing the required drop test.

The analysis performed above on all three alternatives made it clear that a disposable container of any material, would not meet the design requirements, and would prove to be an economically poor decision. Our research in this area did prove to be important, in that it provided us with insight into the type of material (polyethylene) which would eventually be used in our final design.

Reusuable containers which met the specified design constraints were now considered: They included:

a. Stainless steel containers
b. Polyethylene containers
c. Other synthetics containers
d. Existing military gasoline containers

Alternative (a), stainless steel, would meet all design requirements but was determined to be too expensive to fabricate. The synthetics were investigated due to the fact that the methanol/water fuel used has a lower flash point than gasoline and would not require a metal container. Of all synthetics evaluated, alternative (b) proved to be the most economical. Not only would it be easier than the other synthetics to manufacture (due to its extensive use in other similar type containers) but was found to have a lower water absorbtion rate resulting in a more leak resistant container.

Alternative (d) required modification to existing military gasoline cans and was eliminated due to the incompatibility of hydrocarbon fuels with the methanol/water fuel and the specified requirement that the fuel containers developed be "easily distinguishable from Army containers used presently for hydrocarbon fuels."

From these findings, alternative (b) was determined to be our most likely container candidate.

3.2 Polyethylene Versus Other Synthetic Material

Although from our previous analysis a polyethylene container was found to meet the design constraints imposed on our container and was more cost effective, additional evaluation was required to determine its compatability with the methanol/water fuel presently in use with the 1.5 KW fuel cell and the pure methanol proposed for use in the still to be developed 3.5 and 5 KW fuel cells.

Research was performed using various literature references (see Section 7., References), with various plastic and polymeric materials identified as having little or no deterioration in the presence of methanol or methanol blend.

Having used fuel compatability as our analysis requirement all synthetics identified were determined suitable. Additional information would be required in selecting the container material.

3.3 Off The Shelf Item Versus In-House Design

Off the shelf synthetic containers were evaluated using the folowing criteria:

a. Sufficient container handle clearance (sufficient for use with artic mittens)
b. Container stackability
c. Capacity
d. Structural integrity

All containers evaluated lacked the sufficient handle clearance necessary for artic use. As a result, modifications to existing container would have to be accomplished causing stackability (not enough container surface depth) problems and resultant structural integrity problems. AlthoughCommercial containers could satisfy the capacity and cost requirements the design modification problem was too much to overcome.

In-house design of this container, using a synthetic material, requires blow molding technology for fabrication. With this in mind, the following elements were examined:

a. Producbility
b. Cost effectiveness

Preliminary design of the container was accomplished in house and evaluated by outside vendors. Preliminary cost estimates and producibility evalution were performed by these vendors and forwarded to our design engineer. Although the cost exceeded that of the off the shelf alternatives, the container could be made to incorporate all the specified design requirements. This factor alone elimated all other proposed alternatives.

Another inportant factor become evident when proposing our own synthelic blow molded container. Due to the excellent blow molding characteristics of high densty polyethylene the vendors all agreed that this material would be best suited to meeting the military stuctural integrity requirements. Specifically, the uniform thickness of this material throughout the container would assure satisfactory drop testing.

3.4 Conclusions

Having evaluated the above mentioned alternatives the following conclusions were reached:

a. A reuseable container would be used in order to provide the most cost effective product.

b. A high density polyethylene container would be used due to its favorable blow molding characteristics.

c. An in-house design would be used assuring all design requirements were met.

4.0 IN-HOUSE DESIGN; PROBLEMS AND SOLUTIONS

4.1 Characteritics

The high density polyethylene container designed for this contract is rectangular with rounded vertical edges and wider, shorter, and of a different color than the standard military gasoline container. The container incorporates a fitted threaded plug in its opening to permit fuel filtering and enable contamination free fuel transfer. When not filling or transfering fuel from the container, a standard cap with additional saftey chain is secured over the container opening. The container cap incorporates a heat sealed polyethylene sponge covered with a flurocarbon membrane, which provides a seal for the quick disconnect fitting (threaded plug) underneath . The container is marked in red with two labels indicating the flammability and ingestion hazards and one label marked in black indicating the containers use.

4.2 Color

The forest green color required for the container was discovered, through vendor historical data, to have the potiential for contamination (running) when in the presence of a methanol/water fuel. In contrast,high density polyethylene pigmented with carbon black would not only prevent this but would have additional features such as leak, weather, and ultra violet light resistant. A waiver of the specified greencolor was obtained and the carbon black pigment incorporated into our design. This not only provided the above mentioned characteristics but clearly distinguished this container from the standard military gasoline container presently in use.

4.3 Human Factors Engineering

This requirement was one of the most difficult to meet due to the required handle clearance (as mentioned, sufficient for use with artic mittens) which interfered with the stackability requirement. Mounting the fuel transfer hardware also created the same above mentioned problem, while creating a new durability problem. The first attempted solution to these problems, namely a deep drawn handle, created thin spots in the molten plastic, causing it to stretch and thin out rather than flow freely. The design was modified by putting the closure across the part line of the mold and bringing it closer to the top of the container at 45 degrees. This opened up the narrow section between the handle and opening and enabled the mold to flow freely providing the required thickness and resultant required stackability characteristics.

4.4 Durability

One requirement imposed by Department of Transportiation regulations for reusable molded polyethylene cantainers is a minimum wall thickness of 0.045 inch. With our initial design, this became a problem. When the mold was mounted in the press the opening was at the top, around the molding axis of the press. When the molten plastic was blown to fill the mold, the farthest upper and lower corners were thinned. Increasing or varing the weight of the parison failed to produce satisfactory containers because when the molten polyethylene encountered any portion of the mold, its flow was restricted.

The solution devised for this problem was to mount the mold in a vertical position bringing all corners of the mold the same distance from the molding axis. When this is done the blow pin and threaded plug are brought in at an angle and then removed by hand. With this procedure, a relatively consistent mold can be produced and durability guaranteed.

5.0 TESTING

5.1 Requirements

The following tests were required for a predetermined sample of production containers:

a. Weight and critical area thickness test.
b. Department of transportation regulation test
c. Coustomer witnessed drop test
d. Dimensional and associated hardware test.

5.2 Results

Containers selected for fulfillment of the contract were weighed and checked for thickness in critical areas. Those measurements are listed in Table I. On 5 October 1983, DOT regulation tests were conducted to determine compliance with Specification 34; reusable molded polyethylene container for use without overpack). Details of these requirements are found in the Code of Federal Regulation 49, Transportation, paragraph 178.19. The tests were conducted and documented by Container Corporation of America and results shown in Appendix I. No failures were observed in drop tests at ambient 0 and 75 degrees F, hydrostatic tests up to 48 psi, compression test under a 600 pound load for 48 hours, and vibration test for three hours.

On 7 October additional drop tests were carried out in the presence of a U.S. Army Belvoir Research and Development center representative. Results are summarized in Appendix II. A filled container held overnight at 125 degrees F was droped once form six feet and five additional times from eleven feet without leakage or functional damage. Another container at ambient temperature 75 degree F survived drops for six and eleven feet. Two other containers were stored and tested at 20 degrees F. One suffered no damage from drops of six and eight feet but leaked after the cap cracked after an eleven foot drop. The other suffered no damage in the first drop from eleven feet and three previous drops of six, eight, and ten feet. A slight leak was discovered following the second eleven foot drop.

TABLE I

Weight and Minimum Thickness of Methanol/Water Fuel Containers

Cont. No.	Weight lb. oz.	Minimum* Thickness Inches	Cont. No.	Weight lb. oz.	Minimum* Thickness Inches
1	4-12	.039	21	5-4	-
2	5-4	.056	22	4-10	.035
3	5-8	.064	23	5-0	.043
4	5-0	.047	24	5-0	.047
5	5-6	.060	25	5-0	.032
6	5-0	.042	26	4-14	.[illegible]
7 +	5-4	.065	27	4-10	.030
8	5-6	.056	28	5-0	.041
9	4-14	.039	29	4-12	.028
10	5-2	.046	30	5-0	.045
11	5-2	.045	31	4-14	.039
12	5-4	.056	32	5-0	.045
13	5-0	.050	33	5-4	.047
14	5-6	-	34	4-14	.031
15	5-6	-	35	5-2	.045
16	5-4	.054	36	5-2	.038
17	4-12	.036	37	5-0	.042
18	4-14	.043	38	4-12	.039
19	5-2	.048	39 +	4-12	.033
20	5-2	.046	40	4-14	.036

*Measured with Beta gauge

+ These containers were not included in the 38 submitted to U.S. Army Belvoir Research and Development Center.

TABLE II
LOGICAL TECHNICAL SERVICES CORP.

Dimensional Check
Fuel Container and Associated Hardware

Item	Dimension - Name	Value & Tolerance		#3	#7	#12	#18
Container	Overall height	14.00 ± .12		13.984	14.00	14.00	14.046
	Overall width	14.00 ± .12		14.046	14.049	14.093	14.093
	Overall depth	8.00 ± .12		8.120	8.123	8.00	8.000
	Recessed width	13.90 ± .12		13.888	13.888	13.887	13.887
	Recessed depth	7.90 ± .12		8.020	8.020	8.020	8.020
	To lower recess (from bot.)	1.25 ± .06		1.251	1.250	1.250	1.250
	Recess on bottom*	0.250 ± .030		.254	.250	.251	.253
	To upper recess (from top)	4.94 ± .06		4.937	4.936	4.937	4.93
	Clearance under handle	2.75 ± .06		2.75	2.75	2.75	2.75
	Handle depth	.625 ± .030		.615	.615	.612	.612
	Handle width	1.25 ± .06		1.242	1.246	1.245	1.249
	Recess on top*	0.220 ± .030		.246	.247	.246	.246
	Handle clearance-length	4.885 ± .060	*	5.112	5.112	5.110	5.090
	Vertical surf. to cont. edge	4.31 ± .06		4.3125	4.3215	4.310	4.3125
	Horizontal surf. to top	3.56 ± .06		N/A	N/A	N/A	N/A
	Closure surf. (45°) to top	1.375 ± .06		N/A	N/A	N/A	N/A
	Closure surf (45°) to side	1.97 ± .06		1.951	1.931	1.970	1.965
	Closure sur (45°)	3.22 ± .06		N/A	N/A	N/A	N/A
	Closure Pitch	.125		.125	.125	.125	.125
	Exterior Thread Maj. dia.	2.775± .010		X	X	X	X
	Minor dia	2.603± .010		X	X	X	X
	Interior Thread Pitch	.087		X	X	X	X
	Minor dia.	2.285± .010		X	X	X	X
Adapter Assembly	Adapter depth	1.25 ± .01		N/A	N/A	N/A	N/A
	Exterior Thread Maj. dia.	2.370± .010		X	X	X	X
	Minor dia.	2.270± .010		X	X	X	X
	Height of Q.D. fitting above adapt.	0.20 ± .010		X	X	X	X

* For stacking

INSPECTOR [signature] DATE 12/9/83

Q.A. MANAGER P.C Shah for B. Draeger DATE 12/9/83

* LARGER THAN REQ'D DIM'S

PROJ. ENG'R APPROVAL R Barbas for F. McClelland

In fulfillment of paragraph C.4.46 of the contract, the Army representative chose at random four assembled containers for dimensional checks. Table II summarizes the results.

6.0 PRODUCTION RECOMMANDATIONS

6.1 Value Engineering

A Value Engineering Report summarizing production problems, solutions and recommendations is included in Appendix III of this report.

7.0 REFERENCES

Methanol Fuel Modification for Highway Vehicale Use - Keller et al 7-78 pp91-92, II 99-113.

Modifications for use of Methanol-Gasoline Blends in Automotive Vechicles 1-1980 D. J. Patterson et al P77.

Corrosion Can Effect Fuel Systems, Automotive Engineering Vol.87 No 1 PP42-45 January 1979

Alcohol Fuel Prospects, journal of the Institute of Fuel. September 1977, E.M. Goodger pp 132-138

Experience with Methanol-Petrol Blends, Alcohol Fuels, Sydney 9-11 August 1978 E.E Graham and B.T. Judd pp 2-7 to 2-13

Methanol: Its synthesis, Use as a Fuel; Economics, and Hazards D.L. Hagen, 12-76 pp II-10 and II-11

Alcohol Fuels in Automobiles, Alcohol Fuels, Sydney 9-11 Auguest 1978 A. Koeing et al pp 2-1 to 2-6

APPENDIX I

TEST REQUEST No. 10122

10/83
Date

PRODUCT DESCRIPTION 4.3 LTS CONTAINER

Plug/Screwcap 1-70mm Screwcap Poly Resin PH50100 Mfg. Loc. Bldg.6-Wilmington

Initial Torque 300"#

PURPOSE of TEST EVALUATION AND QUALIFICATION OF CONTAINER

Tests to be Performed

Qty.		
6	COLD TEMPERATURE DROPS	Filled to 98% capacity with glycol, conditioned to 0°F., and dropped in the following manner onto solid concrete: Unit #1 - 4' Top Chime, three times Unit #2 - 4' Flat Side, three times Unit #3 - 4' Bottom Chime, three times Unit #4 - 4' Top chime, 6' Flat Side, 8' Bottom Chime Unit #5 - 4' Flat Side, 6' Flat Bottom, 8' Top Chime Unit #6 - 4' Bottom Chime, 6' Top Chime, 8' Flat Side
1	HYDROSTATIC	Filled to 100% capacity with water, pressurized to 15 p.s.i., and tested for five minutes. Increase by 5 p.s.i. increments holding for one minute till 45 p.s.i. is attained or failure occurs.
1	COMPRESSION	Filled to 98% capacity with water and tested at 600# load for 48 hours.
1	VIBRATION	Filled to 98% capacity with water and vibrated for three hours with a fifteen minute static leak analysis after each hour.
1	AMBIENT DROP	Filled to 98% capacity with water and dropped onto solid concrete from a height of four foot in the following manner: First Drop - Top Chime Second Drop - Flat Side Third Drop - Bottom Chime

CONTAINER (S) TEST

LOCATION Wilmington
PERFORMED BY: W. King
UNIT: TYPE 4.3 LTS
CLOSURE 02/70
OVERPACK n/a

AMBIENT
(0°)

DATE 10/5/83
PURPOSE OF TEST: Qualification of Unit - Test Request 10122

TEST	UNIT	#1	#2	#3	#4	#5	#6	#7	#8
1.	4' Top Chime Closure Down	Passed							
2.		Passed							
3.		Passed							
4.	4' Flat Side		Passed						
5.			Passed						
6.			Passed						
7.	4' Bottom Chime			Passed					
8.				Passed					
9.				Passed					
10.	4' Top Chime Closure Down				Passed				
11.	4' Flat Side Closure Down				Passed				
12.	8' Bottom Chime				Passed				

CONTAINER DATA

PLASTIC
RESIN PH 50100
MFG. DATE 9/83
MFG. PLANT Bldg 6-Wilm.

OVERPACK

REMARKS:

CONTAINER (S) TEST

LOCATION Wilmington
PERFORMED BY: W. King
UNIT: TYPE 4.3 LTS
CLOSURE 02/70
OVERPACK n/a

AMBIENT
(0°)

DATE 10/5/83
PURPOSE OF TEST: Qualification of Unit - Test Request 10122

TEST	UNIT	#5	#6	#3	#4	#5	#6	#7	#8
1.	4' Flat Side Closure Down	Passed							
2.	6' Flat Bottom	Passed							
3.	8' Top Chime Closure Down	Passed							
4.	4' Bottom Chime		Passed						
5.	6' Top Chime Closure Down		Passed						
6.	8' Flat Side		Passed						
7.	11' Flat Bottom		Passed						
8.	11' Flat Side	Passed	Passed						
9.	11' Flat Top	Passed							
10.									
11.									
12.									

CONTAINER DATA

PLASTIC
RESIN PH50100
MFG. DATE 9/83
MFG. PLANT Bldg 6-Wilm.

OVERPACK

REMARKS:

HYDROSTATIC PRESSURE TEST

Test Request No.: 10122

Container: 4.3 LTS Date 10/5/83

Closure (s): 02/70 Color: Blk Resin: PH50100

Manufacturing Data: _____

RESULTS:

Unit	Cav.	15 PSI (5 minutes)	25 PSI (1 minute)	35 PSI (1 minute)	45 PSI (1 minute)
#1		Passed	Passed	Passed	Passed
#2					
#3					
#4					
#5					
#6					

NOTES:

Test Performed by:

DATE 10/7/83

TEST REQUEST NO. 10122

COMPRESSION TEST

IDENTIFICATION AND DESCRIPTION OF CONTAINER: 4.3 LTS

MANUFACTURED BY: Bldg 6 - Wilmington RESIN: PHS0100

CONTAINER WEIGHT: _____ MINIMUM WALL THICKNESS: _____

WALL THICKNESS AT 5 LOCATIONS, 90° FROM PARTING LINE:

	A	B	C	D	E
HEIGHT (INCHES)					
WALL THICKNESS (MILS)					

DATE	TIME	LOAD	HEIGHT	DEFL.	AMB. TEMP.	READ BY
10-4-83	4:35P	-	13 7/8"		79°F	
10-4-83	4:45P	600#	13 5/8"	1/4"	79°F	
10-6-83	5:18P	600#	13 1/2"	3/8"	79°F	

DATE 10/6/83

VIBRATION TEST

TEST REQUEST #: 10122 PERFORMED BY: W. McCoy

CONTAINER: 4.3 LTS

CLOSURE: 02/70 OVERPACK: n/a

UNIT	#1	#2	#3
Manufacturing Plant W Manufacturing Date 9/83	Closure 02 70	Closure	Closure
Starting torque	___ 300"# ___ ___	___ ___ ___ ___	___ ___ ___ ___
Torque reading at end of 1st hour	___ ___ ___ ___	___ ___ ___ ___	___ ___ ___ ___
Results at end of 1st hour	Passed		
Torque reading at end of 2nd hour	___ ___ ___ ___	___ ___ ___ ___	___ ___ ___ ___
Results at end of 2nd hour	Passed		
Torque reading at end of 3rd hour	___ ___ ___ ___	___ ___ ___ ___	___ ___ ___ ___
Results at end of 3rd hour	Passed		

NOTES:

All torque values stated in inch/lbs unless otherwise noted

APPENDIX II

CAPACITY CHECK

SELF SUPPORTED UNITS

	Unit #	Unit #
Gallonage	4.3	
Type	LTS	
Closure	02/70	
Color	Black	
Overall Hght.	13 7/8"	
Mfg. Date	9/83	
Machine #	Bldg. 6	
Cavity #	1	
Water Temp.	70°F	
Capacity	4.8	

NOTES:

T. Udell
Test Performed By:

10/7/83
Date.

CONTAINER (S) TEST

LOCATION Wilmington
PERFORMED BY: T. Udell
UNIT: TYPE 4.3 LTS
CLOSURE 02/70
OVERPACK n/a

AMBIENT
(+126°)

DATE 10/7/83
PURPOSE OF TEST: Qualification for military specification

TEST	UNIT	#1	#2	#3	#4	#5	#6	#7	#8
1.	6' Top Chime Closure Down	Passed							
2.	11' Flat Side Closure Down	Passed							
3.	11' Flat Side Closure Down	Passed							
4.	11' Bottom Chime	Passed							
5.	11' Top Chime Closure	Passed							
6.									
7.									
8.									
9.									
10.									
11.									
12.									

CONTAINER DATA

PLASTIC
RESIN PN 50100
MFG. DATE 9/83
MFG. PLANT Bldg 6 - Wilm

OVERPACK
n/a

REMARKS:

B2

CONTAINER (S) TEST

LOCATION Wilmington
PERFORMED BY: T. Udell
UNIT: TYPE 4.3 LTS
CLOSURE 02/70
OVERPACK n/a

AMBIENT
0°

DATE 10/7/83
PURPOSE OF TEST: Qualification for military specification

TEST	UNIT	#1	#2	#3	#4	#5	#6	#7	#8
1.	6' Flat Side Closure Down	Passed							
2.	11' Top Chime Closure Down	Passed							
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
11.									
12.									

CONTAINER DATA

PLASTIC
RESIN PH50100
MFG. DATE 9/83
MFG. PLANT Bldg 6-Wilm.

OVERPACK
n/a

REMARKS:

B3

CONTAINER (S) TEST

LOCATION Wilmington
PERFORMED BY: T. Udell
UNIT: TYPE 4.3 LTS
CLOSURE 02/70
OVERPACK n/a

AMBIENT
(-20°)

DATE 10/7/83
PURPOSE OF TEST: Qualification for military specification

TEST	UNIT	#1	#2	#3	#4	#5	#6	#7	#8
1.	6' Top Chime Closure Down	Passed							
2.	8' Flat Top	Passed							
3.	11' Flat Side Closure Down	Failed							
4.	6' Flat Bottom		Passed						
5.	8' Flat Top		Passed						
6.	10' Top Chime Closure Down		Passed						
7.	11' " " " "		Passed						
8.	11' Flat Side Closure Down		Failed						
9.									
10.									
11.									
12.									

CONTAINER DATA

PLASTIC
RESIN PH50100
MFG. DATE 9/83
MFG. PLANT Bldg. 6 - Wilm.

OVERPACK
n/a

REMARKS: Unit #1 - Failure occured due to screwcap cracking
Unit #2 -

B4

APPENDIX III

LOGICAL TECHNICAL SERVICES CORP.
FEDERAL SYSTEMS DIVISION
(609) 393-2222
675 Prospect Street Trenton, NJ 08618

APPENDIX III

24 May 1984

U.S. Army Mobility Equipment Research
and Development Command
Procurement and Production Directorate
Fort Belvois, VA 22060

Attn: Mr. Stanley S. Kurpit STRBE-ECS-1

Subject: Contract DAAK70-81-C-0194 Final Value Engineering Report CLIN 0004

On 14 February 1984, Logical Technical Services Corp. submitted a Final Value Engineering Report for work completed under CLIN 0004, Contract DAAK70-81-C-0194.

Five (5) copies of an updated Final Value Engineering Report are enclosed.

Sincerely yours,

LOGICAL TECHNICAL SERVICES CORP.

F.O. Perry
Manager, Instruments Division

cc: STRBE - ECS 2
STRBE - DE 2
STRBE - PEA 1

TABLE OF CONTENTS

1. GENERAL

All work documented in this report is in response to Contract DAAK70-81-C-0194, Methanol/Water Fuel Containers.

1.1 Introduction

A Value Engineering Analysis was performed in response to CLIN 0004 (Value Engineering Program). This effort was ongoing throughout Prototype Fabrication and Test (CLIN 0002) and Production Fabrication and Test (CLIN 0003).

Section 2. of this report contains the background of the Methanol/Water Fuel Container program while Section 3. contains the Value Engineering Analyses and Conclusions. Value Engineering Review Sheets are contained in Appendix I.

2. BACKGROUND

Following approval of the Engineering Design Package on 4 May 1982, the design for the container was submitted to several blow molder manufacturers for quotation. All declined to quote because of fears that the design would cause the first container molded to be captured in the mold. After redesign of the container and assurance from reputable molders that it could now be produced, the revised package was approved by the U.S Army and the contract extended from August to December 1983. As a result of the redesign, the decision was made not to build a mold for the outside cap adapter. This resulted in a higher piece part price due to additional machining, but an overall savings for the program through reduction of tool costs.

Containers were molded in September 1983, satisfactorily tested in October, and delivered to the customer in December, 1983.

Value engineering was taken into consideration throughout all phases of this contract. A formal Value Engineering Plan was prepared and submitted to the customer on 15 January 1982, and approved on 11 February 1982. The formal value engineering effort began following the Critical Design Review held on 1 March 1982.

3.0 ANALYSES AND CONCLUSION

The overwhelming portion of cost of the methanol/water fuel containers is the molded container itself, both in terms of tool cost, including set up, and the molding of the container. Significant value engineering progress can only be accomplished through volume production, which would amortize the mold and set up costs over a larger production run. With the existing low volume mold, potential gains are limited because considerable manual manipulation is required between cycles. This slows down the cycle and requires an additional operator as well. If high volume production (more than 1000 containers) is anticipated, a new mold or at least rebuilding the present one should be considered. This will involve moving the container opening from 45 degrees to vertical and permitting automatic removal of the blow pin and threaded plug on which the interior threads of the container are formed.

Other changes worthy of consideration with high volume production include molds for the adapter and the outer cap. Molding the adapter with the male quick disconnect coupling as an insert will save machining of the adapter and the coupling, eliminate the face bushing, and simplify overall assembly. Molding a custom cap with a tab, (for securing the chain to the cap) would eliminate the operation of heat sealing a tab on a commercial cap. The break-even point for this change would be approximately 3000 containers.

A valved male quick disconnect coupling should also be considered in later production phases. This will eliminate the polyethylene sponge heat sealed to the inside of the container cap which was used to prevent leakage of fuel into the area above the adapter during transport.

LOGICAL TECHNICAL SERVICES CORP.

TRENTON, NJ

VALUE ENGINEERING REVIEW

CONTRACT OR PROGRAM I.D. DAAK70-81C-0194 REVIEW NO. 1

DATE: 7 May 1982

SHEET 1 OF 1

PROGRAM PHASE: (Indicate One)

DEVELOPMENT _____ DESIGN x MANUFACTURING _____

ITEM (Continue Items on attached supplement sheets if required)

1.0 REVIEW ACTION: (Indicate requirement and Scope)

Following Critical Design Review on 1 March 1982 and meeting 4 May 1982, prepare molded item for mold and part cost quotation, check standard components for availability and competitive quotations.

2.0 ATTENDEE: (List all individuals involved in Review and Titles)

B. Draeger QA/Value Engineer, S.S. Kurpit (through CDR and by phone contact), USA Belvoir R&D Center Development Project Officer, F. McClelland Project Engineer

3.0 REVIEW RESULTS: (Indicate Function/Cost or Material/Product/Cost Relationship) Include List of Supporting Documents.

See Cost-Model Analysis #1.B. Draeger questioned threaded interface between adapter and container. Suggested snap fitting bonded in place, need to leave nonfunctional dimensions on container open for mold builder discretion.

4.0 COMMENTS: (Indicate comments to Review Results)

S. Kurpit requested screen to keep out dirt and polyethylene cover to protect from rain. Also more specific designation of methanol resistant adhesive for labels. Re: Draeger question, Kurpit prefers threaded interface for easy disassembly.

5.0 CONCLUSION: (Indicate Action Items which results from Comments)

Kurpit's suggestion accepted. Draeger's proposal deferred. Noncritical dimensions will be at discretion of mold builder and submitted to USA Belvoir R&D Center when available.

6.0 DISPOSITION: (Indicate Final Disposition of Action Items noted)

Screen and polyethylene cover incorporated into design. Bill of material on assembly print will specify adhesive supplied by M & C Specialties. Snap fit for adapter/container interface will be deferred for consideration until production quantities are needed.

VALUE ENGINEER SIGNATURE

LOGICAL TECHNICAL SERVICES CORP.

TRENTON, NJ

COST-MODEL ANALYSIS #1

DEVELOPMENT MODEL, SUPPORTING ITEMS

CONTRACT OR PROGRAM I.D.: DAAK70-81-C-0194 DATE: 7 May 1982

REVISION: _____

PRIME ITEM DESCRIPTION: Assembled fuel container with auxiliary hardware

MAJOR COST ELEMENTS: (List all cost elements required in support of prime item)

ELEMENT	SOURCE	ESTIMATE COST		TOOL/SET COST
		40 Units	1000 Units	
Container	Newton Plastics	E25.00	4.70	33,000
Adapter	Croydon Plastic Co.	E 1.50	.75	5,000
Cap		E 1.00	.50	4,000
Chain	Eastern Chain	.65	.29	
Cap/Chain Assembly	LTS	E .75	.35	100
Label-Warning		3.39	.38	30
Label-Use		3.25	.35	30
Male QD Coupling		Q 2.00	1.50	
Tube Fitting		Q .59	.59	
Tubing		Q .38	.14	
Gasket (2)		E .50	.10	
Screen		Q 1.45	.28	30
Assembly	LTS	E 3.00	1.50	
TOTAL		43.66	11.53	42,190

COMMENTS: (Explain any variations between estimat-/actual costs)

VALUE ENGINEER SIGNATURE

LOGICAL TECHNICAL SERVICES CORP.

TRENTON, NJ

COST-MODEL ANALYSIS #1

DEVELOPMENT MODEL, SUPPORTING ITEMS

CONTRACT OR PROGRAM I.D DAAK70-81-C-0194 DATE:7 May 1982

REVISION:

PRIME ITEM DESCRIPTION: Assembled Fuel Container

MAJOR COST ELEMENTS: (List all cost elements required in support of prime item)

ELEMENT	SOURCE	ESTIMATE COST		ACTUAL COST
		40 Units	1000 Units	
emale Quick Disconect fitting	Airline Hydraulics	Q2.55	2.17	
lapter 1/4" pipe thd 37° fitting	Airline Hydraulics	Q .39	.39	
lyethylene Cover		E .20	.10	

COMMENTS: (Explain any variations between estimate/actual costs)

VALUE ENGINEER SIGNATURE

LOGICAL TECHNICAL SERVICES CORP.

ENGINEERING CHANGE NOTICE

Contract DAAK70-81-C-0194

Page 1 Of 1

ECN No.

Unit Affected: Methanol-Water Fuel Container

Cust Approval Authority Per

Job Order Task 1

FULLY APPROVED. THIS NOTICE OFFICIALLY UPDATES THE DOCUMENT TO WHICH IT IS ATTACHED.

CHANGE CLASS (PER ANA BULL. 445)
☒ Class I ☐ Class II
Cont. Adm

STOP WORK ORDER NO.
IS: ☐ Continued
☐ Released by this ECN.

Concurrent With Marked Prints ☐

Release Status: ☐ ☒ ☐ File Dev. Prod

Documents Affected: LTS 0002, 0005, 0006, 0008, 0009, 0011, 0012, 0013, 0015

Reason for Change: Container (LTS 0006) cannot be molded as designed

CHANGE GRADE
☒ Design Deficiency
☐ Error Correction
☒ Value Engr.
☐ Clarification
☐ Non Technical

DATA CONTROL ONLY
☐ ECN only
☐ Partial Release
☐ Complete Release

Change Description (List Each Document No. And Change Description Separately)

Adapter LTS 0002D replaced by Adapter Assembly LTS 0013D.
Methanol-water fuel container assembly LTS 0005E replaced by LTS 0015E.
Methanol-water fuel container LTS 0006E replaced by LTS 0012E.
Cap - fuel container LTS 0008A deleted. Replaced by commercial cap and note on 0015.
Cap and chain assembly LTS 0009A deleted.
Cover and assembly LTS 0011A deleted.

CHANGE EFFECTIVITY
☒ Immediate
☐ After
☐ Mat'l not Affected

MATERIAL STATUS
☐ Stock ☒ N/A
☐ Part in Process
☐ Completed

DISPOSITION
☐ Obsolete ☐ Scrap
☒ Rework ☐
☐ Use as is

CHANGE AFFECTS
☒ Engineering ☐ Prod. Control
☐ Publications ☒ Manufacturing
☐ Qual. Assur.

REMARKS

REJECTED BY: Date
REASON

Engr. Mgr. Date

Approved for Incorporation
Data Control Mgr. Date

Requestor FMc 21Sep82 Date

Prepared By FMc 21Sep82 Date

Incorporated By Date

Program Mgr. Date

Engineering FMc 9-21-82 Date

Prod Cont. N/A Date

Manu. N/A Date

Q.A. Mgr. 9/21 Date

Form No. E-018D-1

LOGICAL TECHNICAL SERVICES CORP.

TRENTON, NJ

VALUE ENGINEERING REVIEW

CONTRACT OR PROGRAM I.D. DAAK70-81-C-0194 REVIEW NO. 2

DATE: 21 September 1982

SHEET 1 OF 1

PROGRAM PHASE: (Indicate One)

DEVELOPMENT x DESIGN _____ MANUFACTURING _____

ITEM (Continue Items on attached supplement sheets if required)

1.0 REVIEW ACTION: (Indicate requirement and Scope)

Following Critical Design Review on new container design on 8 September 1982 and meetings with Kennedy Tool & Die and Container Corporation of America (CCA), this redesign simplified the adapter and made possible the use of a standard plug cap.

2.0 ATTENDEE: (List all individuals involved in Review and Titles)

B. Draeger, LTS QA/Value Engineer, S.S. Kurpit, USA Belvoir R&D Center Project Officer, T.H. Udell CCA Manager Product Devel. Al Yount, Kennedy T&D. mold designer, F. McClelland, LTS Project Engineer.

3.0 REVIEW RESULTS: (Indicate Function/Cost or Material/Product/Cost Relationship) Include List of Supporting Documents

See Cost-Model Analysis #2 ECN No. 1 Udell suggested molding internal and external threads on the container opening. A commercially available plug cap could then be used for the adapter. A commercial cap could be modified to allow attachment to the container through a chain. Udell also proposed fluorocarbon membrane to eliminate screen and polyethylene cover.

4.0 COMMENTS: (Indicate comments to Review Results)

Kennedy proposed widening the narrow sections between the handle and the container opening and placing the mold part line across the opening and along the length of the handle. CCA concurred with the changes. Using commercial cap and plug for the adapter saves the cost of molds and lead time for building.

5.0 CONCLUSION: (Indicate Action Items which results from Comments)

1. Order mold for container through CCA to permit molding follow through.
2. Order plug caps from CCA and arrange for machining
3. Replace screen and PE cover with fluorocarbon membrane and bond to adapter.
4. Order caps and arrange for modification.

6.0 DISPOSITION: (Indicate Final Disposition of Action Items noted)

Issue purchase order to CCA for mold, plug caps and machining. Issue purchase order for caps from Rieke.

VALUE ENGINEER SIGNATURE

LOGICAL TECHNICAL SERVICES CORP.

TRENTON, NJ

COST-MODEL ANALYSIS #2

DEVELOPMENT MODEL, PRIME ITEM

CONTRACT OR PROGRAM I.D. DAAK70-81-C-0194 DATE: 21 Sept 1982

REVISION: #1

PRIME ITEM DESCRIPTION: Assembled Fuel Container with Auxiliary hardware

MAJOR COST ELEMENTS: (List all cost elements related to Prime Item)

ELEMENT	SOURCE	ESTIMATE COST	ACTUAL COST
HDPE Container	CCA	25.00	
Use& Warning labels		6.64	6.64
Adapter	CCA	.50	
Machining of adapter	Through CCA	24.50	
Fluorocarbon membrane	Chemplast Inc. Z-110	.30	
Membrane assembly	CCA	2.00	
3/8" x 3/4" bushing		2.00	
Male Quick Disconnect fitting	Airline Hydraulics	2.00	2.00
Machining of fitting	CN Wood	4.00	
Polyethylene tubing	Kaufman Glass Co Wilmington,DE	.25	
Tubing Connector	Airline	.59	
Polyethylene tubing	Rieke	.50	
Polyethylene rod	Kaufman Glass Co.	.10	
Brass safety chain		.65	
Jack Chain Link		.05	
Washers (2)		.10	
Assembly		8.00	
Total		77.18	

COMMENTS: (Explain any variations between estimate/actual costs)

VALUE ENGINEER SIGNATURE

LOGICAL TECHNICAL SERVICES CORP.

TRENTON, NJ

COST-MODEL ANALYSIS #2

DEVELOPMENT MODEL, SUPPORTING ITEMS

CONTRACT OR PROGRAM I.D. DAAK70-81-C-0194 DATE: 21 Sept 82

REVISION: #1

PRIME ITEM DESCRIPTION: Assembled Fuel Container

MAJOR COST ELEMENTS: (List all cost elements required in support of prime item)

ELEMENT	SOURCE	ESTIMATE COST		ACTUAL COST	
		QTY	UNIT COST	QTY	UNIT COST
Female Quick Disconnect coupling	Airline Hydraulics	40	2.55		2.55
Adapter 1/2" pipe thd to 37° fitting	Airline hydraulics	40	.39		.39

COMMENTS: (Explain any variations between estimate/actual costs)

VALUE ENGINEER SIGNATURE

LOGICAL TECHNICAL SERVICES CORP.

TRENTON, NJ

VALUE ENGINEERING REVIEW

CONTRACT OR PROGRAM I.D. DAAK70-81-C-0194 REVIEW NO. 3

DATE: 7 Oct 1983

SHEET 1 OF 1

PROGRAM PHASE: (Indicate One)

DEVELOPMENT _____ DESIGN _____ MANUFACTURING x

ITEM (Continue Items on attached supplement sheets if required)

1.0 REVIEW ACTION: (Indicate requirement and Scope)
Observe testing of assembled containers
Evaluate assembly and function of containers

2.0 ATTENDEE: (List all individuals involved in Review and Titles)
S.S. Kurpit, USA Belvoir R&D Center Project Officer, T.H. Udell Manager Product Development Container Corp., of America Wilm. DE, B. Draeger QA/Value Engineer LTS Corp., F. McClelland Project Engineer LTS Corp.

3.0 REVIEW RESULTS: (Indicate Function/Cost or Material/Product/Cost Relationship) Include List of Supporting Documents.
Containers met or exceed requirements for DOT certification and contract drop test specifications.Mr. Kurpit not satisfied with threaded fit between adapter and containe

4.0 COMMENTS: (Indicate comments to Review Results)
Mr. Udell proposed use of Advanced Chemical Technology A10B plug with machined threads to fit container as adapter.

5.0 CONCLUSION: (Indicate Action Items which results from Comments)
A10B plugs obtained by LTS, machined by subcontractor of CCA. Fluorocarbon membranes heat sealed over vent hole in plug/adapter by LTS. Assembly completed by LTS.

6.0 DISPOSITION: (Indicate Final Disposition of Action Items noted)
Thirty-eight containers assembled and prepared for delivery to MERADCOM.

VALUE ENGINEER SIGNATURE

LOGICAL TECHNICAL SERVICES CORP.

ENGINEERING CHANGE NOTICE

Contract DAAK70-81-C-0194

Page 1 of 1

ECN No.

Unit Affected: Methanol-Water Fuel Container

Cust Approval Authority Per

Job Order

Task

FULLY APPROVED, THIS NOTICE OFFICIALLY UPDATES THE DOCUMENT TO WHICH IT IS ATTACHED.

CHANGE CLASS (PER ANA BULL. 448)
☒ Class I ☐ Class II
Cont Adm

STOP WORK ORDER NO.
IS: ☐ Continued. ☐ Released by this ECN.

Concurrent With Marked Prints ☐

Release Status: ☒ File Dev. ☐ Prod ☐

Documents Affected: LTS 0013C, 0015E

Reason for Change: Cap-plug from CCA replaced by plug A10B from Adv.Chem Techn with machined external thread to improve fit.

CHANGE GRADE
☐ Design Deficiency
☒ Error Correction
☒ Value Engr.
☐ Clarification
☐ Nprf Technical

DATA CONTROL ONLY
☐ ECN only
☐ Partial Release
☐ Complete Release

Change Description (List Each Document No. And Change Description Separately)

Adapter assembly LTS 0013C - Redrawn (formerly LTS 0013D)

Methanol-water fuel container LTS 0015E Revised

CHANGE EFFECTIVITY
☒ Immediate
☐ After
☐ Mat'l not Affected

MATERIAL STATUS
☐ Stock ☒ N/A
☐ Part in Process
☐ Completed

DISPOSITION
☐ Obsolete ☐ Scrap
☐ Rework ☒ N/H
☐ Use as Is

CHANGE AFFECTS
☐ Engineering ☐ Prod. Control
☐ Publications ☒ Manufacturing
☐ Qual. Assur.

REMARKS

REJECTED BY. Date
REASON

Engr. Mgr. Date

Approved for Incorporation
Data Control Mgr. Date

Requestor Date FMc 7Dec83

Prepared By Date FMc 7Dec83

Incorporated By Date RDG 7Dec83

Program Mgr. Date

Prod Cont. Date

Manu. Date

Engineering Date FMc 12-8-

Q.A. (Rel) Date 12/8

Form No. E-0180-1

LOGICAL TECHNICAL SERVICES CORP.

TRENTON, NJ

COST-MODEL ANALYSIS

DEVELOPMENT MODEL, SUPPORTING ITEMS

CONTRACT OR PROGRAM I.D.: DAAK70-81-C-0194 DATE: 15 Nov 83

REVISION: 2

PRIME ITEM DESCRIPTION: Assembled Fuel Container

MAJOR COST ELEMENTS: (List all cost elements required in support of prime item)

ELEMENT	SOURCE	ESTIMATE COST		ACTUAL COST	
		QTY	UNIT COST	QTY	UNIT COST
HDPE Container	CCA	1000	21.00	40	70.00
Adapter	Polydrum Div.		.40		.40
Machining of Adapter	Advanced Chem Tech Through CCA		4.00		5.00
Fluorocarbon membrane	Chemplast Inc. 2-110		.50		.50
Membrane Assembly	by LTS		.40		.50
Face bushing	Trenton Pipe Nipple Corp		1.20		1.30
Male Quick Disconnect Coupling	Airline Hydraulics		1.40		2.00
Machining of fitting	C.N. Wood Mfg Co		3.00		4.00
Polyethylene tubing	Kaufman Glass		.15		.25
Tubing connector	Airline Hydraulics		.59		.59
Polyethylene Cap	Rieke		.50		.50
Polyethylene Sponge					
Polyethylene rod	Kaufman Glass		.05		.10
Brass safety chain			.02		.10
S hook	Newtown Hardware		.25		.40
Washer (2)	Newtown Hardware		.02		.05
Warning & use labels	Plastic/Metal Prod.		.05		.10
Assembly	M & C by LTS		.73		6.64
			2.50		7.50
Total			36.76		99.93

COMMENTS: (Explain any variations between estimate/actual costs)

VALUE ENGINEER SIGNATURE

LOGICAL TECHNICAL SERVICES CORP.

TRENTON, NJ

COST-MODEL ANALYSIS

DEVELOPMENT MODEL, SUPPORTING ITEMS

CONTRACT OR PROGRAM I.D. DAAK70-81-C-0194 DATE: 15 Nov 83

REVISION: 2

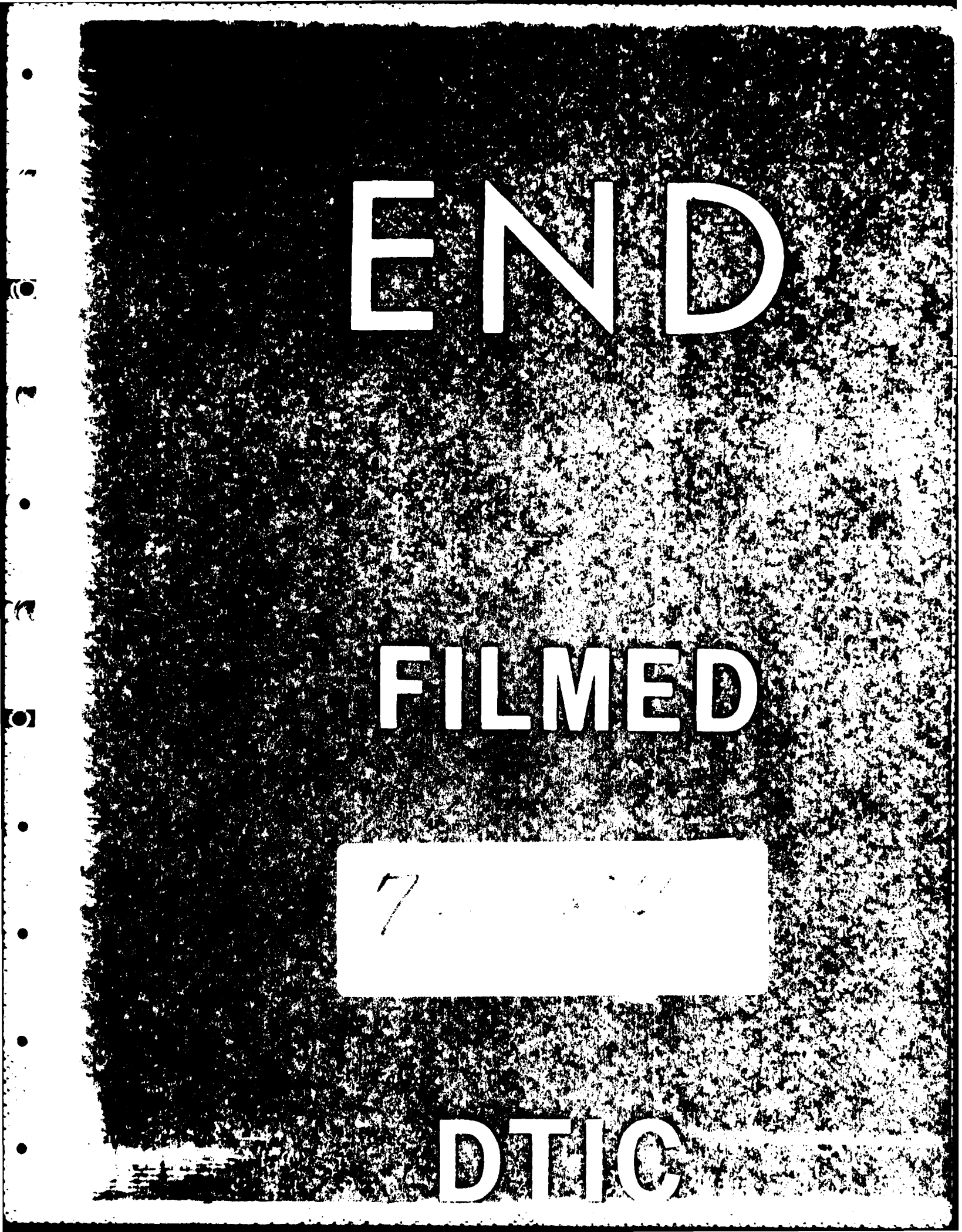
PRIME ITEM DESCRIPTION: Assembled Fuel Container

MAJOR COST ELEMENTS: (List all cost elements required in support of prime item)

ELEMENT	SOURCE	ESTIMATE COST		ACTUAL COST	
		Qty	Unit Cost	Qty	Unit Cost
Female Quick Disconnect Coupling	Airline Hydraulics	1000	2.17	40	2.55
Adapter 1/4" pipe thd to 37° fitting	Airline Hydraulics	1000	.39	40	.39

COMMENTS: (Explain any variations between estimate/actual costs)

VALUE ENGINEER SIGNATURE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